

## Measuring Environmental Efficiency of Energy in OPEC Countries

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**Abstract :** Data envelopment analysis (DEA) has recently gained popularity in energy efficiency analysis. A common feature of the previously proposed DEA models for measuring energy efficiency performance is that they treat energy consumption as an input within a production framework without considering undesirable outputs. However, energy use results in the generation of undesirable outputs as byproducts of producing desirable outputs. Within a joint production framework of both desirable and undesirable outputs, this paper presents several DEA-type linear programming models for measuring energy efficiency performance. In addition to considering undesirable outputs, our models treat different energy sources as different inputs so that changes in energy mix could be accounted for in evaluating energy efficiency. The proposed models are applied to measure the energy efficiency performances of 12 OPEC countries and the results obtained are presented.

**Keywords :** energy efficiency, undesirable outputs, data envelopment analysis

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